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Working for Clean Water

An Information Program for Advisory Groups

Water Conservation and Reuse

Why conserve water?

How can we plan the future water supply for droughts and every-day needs?

Is it economical to conserve water?

Can we save energy by conserving water?

How can we implement water conservation?

Citizen Handbook

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EP 1.8/12

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This information program was financed with federal funds from the U.S. Environmental Protection Agency under Cooperative Agreement No. CT900960 01. The information program has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Water Conservation and Reuse

Why Conserve or Reuse Water?

Man's existence and cultural development has revolved around water. Water is used for drinking as well as transportation, industry, commerce, and waste disposal. Most large population or industrial centers are located on, and critically dependent upon, good water supplies.

Water Shortages

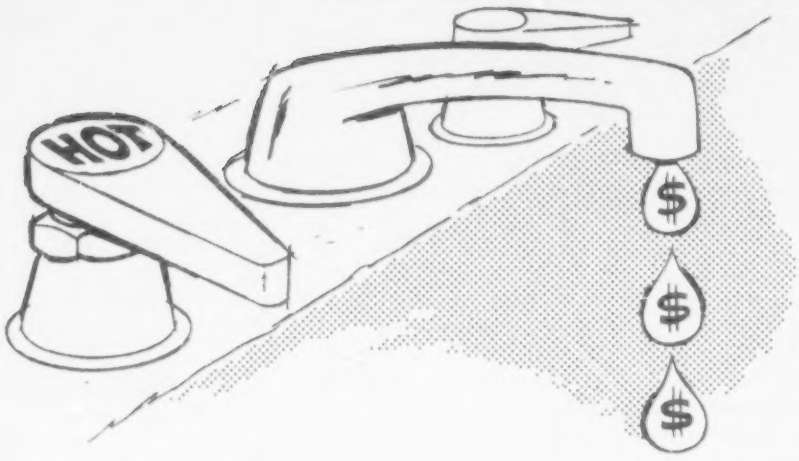
Some areas of the United States have abundant supplies of high quality water that meet year-round needs. Other areas have only a limited supply of water of acceptable quality. Numerous examples of chronic water shortages can be found in the Southwest. Other geographical areas face seasonal shortages. Salt water intrusion is a serious problem in coastal areas where groundwater has been seriously depleted. Yet in other cases where there is adequate water quantity, the quality makes it only marginally usable. Examples include the acid mine drainage water of Appalachia, and water containing high levels of dissolved solids found in the Southwest. Periodic droughts combined with an inadequate water supply produce a crisis situation. The Northeast suffered its worst long-term drought from 1961 to 1965. California suffered a devastating drought during 1976 and 1977. Other more localized droughts occur every year, and have a significant effect on communities. *The need for water conservation becomes more important in light of increasing population and increasing per capita demand.*

Wastewater Treatment Plant Overload

Wastewater treatment plants have to be adequately sized to meet the wastewater flows produced by the community. However, industrial, commercial, and residential users often produce excessive flows. These large flows overload the treatment system, which then cannot function properly. Reduction of these wastewater flows by water conservation may make the facilities last longer or produce effluent of improved quality. However, excessive infiltration and inflow (I/I), which are leaks of ground or surface waters into sewers, may overshadow any benefits that result from water conservation. **In these cases the citizen advisory group should promote control of I/I as well as water conservation.**

Onsite Disposal

Onsite wastewater disposal from a septic tank is used by 29 percent of the total households in the United States. More would be used, but the soils and topography of many sites are not well-suited for the effluent disposal. For example, 80 percent of Pennsylvania's land is unsuitable for onsite systems. Water conservation reduces wastewater flows and offers the potential for improved treatment on many sites. It also permits disposal on some previously unacceptable sites.



Energy

Energy can be saved by water conservation. By using less water, sizable savings in electrical consumption for pumps, and electricity or fuel used for hot water, can be realized. Additional savings result through reduction in chemical usage at treatment plants. Part of chemical costs represents the energy consumed in mining, manufacture, and transportation of the materials.

Regulatory Policy

The Clean Water Act of 1977 recognizes that water conservation will improve water quality. It includes provisions that encourage economic water saving measures. Water conservation increases both efficiency and longevity of treatment facilities. If the amount of water treated by a plant can be reduced, the size of the plant and the operational costs can also be reduced. This will extend federal dollars for pollution abatement and permit the construction of more treatment plants.

Section 104 of the Act requires the United States Environmental Protection Agency (EPA) to conduct research into methods that can reduce wastewater flow. Section 201 states that the EPA shall encourage wastewater treatment technology that reclaims wastewater for other uses. Section 201 also requires the consideration of innovative and alternative technologies that result in water reuse and recycle. The Act provides increased funding for those projects using alternative technologies, raising the federal share from 75 percent to 85 percent of construction costs.

The Safe Drinking Water Act of 1974 takes another approach to water conservation by providing funds for demonstration projects that will investigate the health implications of reuse and recycling of water for potable use.

President Carter in 1977 asked the federal government to review water resource policy "with Water Conservation as its cornerstone." Specific directives to federal agencies include:

- Requiring water conservation as a condition of federal funding for: water supply and wastewater treatment grants of the EPA, housing programs of HUD, and USDA, and contracts for water supply from federal projects of the Bureau of Reclamation, USDA, DOE, Army Corps of Engineers, and the TVA
- Requiring water conservation in federal buildings
- Encouraging water conservation in agricultural assistance programs, and providing technical assistance in water-short areas.

Cost-Effectiveness Analysis

The EPA requires evaluation of the cost-effectiveness of flow reduction measures during Step 1 planning of the 201 construction grant process. However, this is required only if the community is larger than 10,000 people, and average water use is greater than 70 gallons per person per day. The water conservation alternatives include water pricing changes, use of water meters, use of low flow devices such as toilet dams in homes, public education, and changes in plumbing codes to require installation of water-saving devices in future homes.

Savings in water and energy at the present and 20 years into the future are to be analyzed. Water and sewage treatment and transmission costs are also to be considered, both with and without conservation measures.

Plumbing Codes

Many communities have adopted plumbing codes requiring the installation of residential water-conserving devices in new construction. The first area to adopt such a strategy was the Washington Suburban Sanitary Commission in Maryland because of short water supplies in the Potomac River watershed and overloaded wastewater treatment plants.

Similar measures have been legislated in California and Georgia. Other states are also considering plumbing codes that promote water conservation.

Water Use and Wastewater Production

Water use and wastewater production go hand in hand. For example, 90 percent of municipal waters end up in the sewer. Water conservation thus alleviates both supply and disposal problems because water that is not used doesn't have to be treated.

Industrial, Commercial, and Agricultural Uses

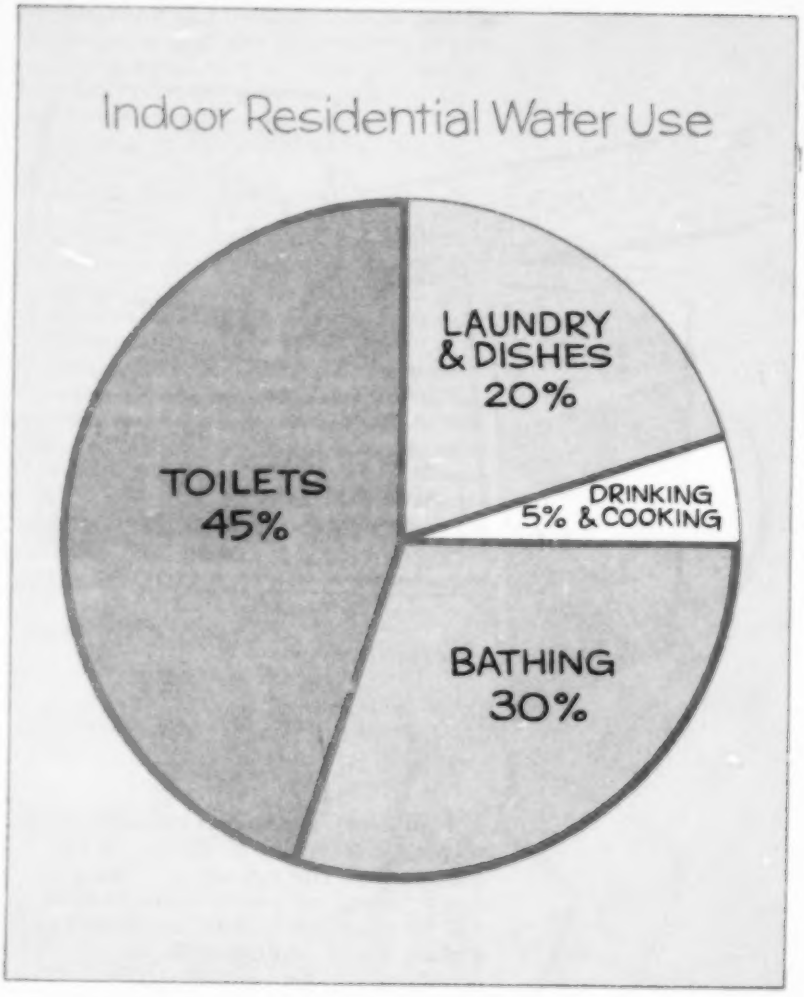
Industrial water accounts for 40 percent of the water used in the United States. Industrial wastewater production may be the easiest to control. Industry often must treat water before using it, and is motivated economically to recycle its wastewater and conserve water. It may be possible through a change in water rates to significantly reduce industrial flows. The trend in many water-consuming industries is towards the total recycling of water within the plants. Potable water use and sanitary waste production are often only a small part of industrial flows.

The volume of water used by commerce (i.e., businesses) is not as great as the volume used by industry. However, water used for human consumption and sanitation, such as drinking, bathing, washing, and toilet use, makes up a much larger fraction of the total commercial use. Therefore, many residential water conservation devices are applicable to commercial situations. Commerce, like industry, is motivated by economics and changes in pricing may have significant impacts.

Agricultural water use is related to the crops grown and the geographic area. Agricultural water use accounts for 50 percent of total United States water use. Many new techniques are being developed to reduce irrigation water needs.

Residential Uses

Residential water use has not been seriously studied until recently. Generally accepted average use of individual systems is 50 gallons per capita per day, and for public systems it is 73 gallons per capita per day. The two major household uses are for bathing and toilets.



Implementing Water Conservation Plans

Public education is a key to water savings. Although it is difficult to evaluate the actual savings from an education program water reductions of 20 percent appear possible without too much hardship. One effective municipal district's public education campaign took the form of:

- Printed inserts included with water bills
- Posters placed throughout the community

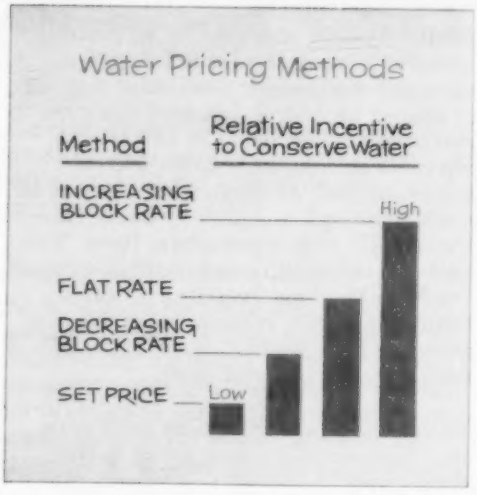
- Reminder items such as buttons, key chains, matchbooks, and litterbags
- Public service announcements on radio and TV
- Speakers and motion picture films sponsored by the utility
- Help from volunteer groups
- Conservation education programs in schools.

The advisory group can recommend a water conservation program for its community. The agency or body that has a vested interest in conservation will be the most willing to support such a plan. Water utilities with supply problems can be very effective. Overloaded wastewater treatment utilities can also actively participate. If the conservation objective is long term, not merely a solution to an immediate problem, it may require different action. Then the local or state government may need to start an education program. The advisory group should be sure that water conservation is carefully considered during the cost-effectiveness analysis of facility planning.

Pricing

Water pricing can impact the consumption of water. Most utilities establish rates to recover the cost of services, high rates can accomplish much more. It may be necessary to encourage your utility to review traditional pricing policies in light of water shortages or water quality difficulties. These reviews can be encouraged by public education and legislation.

There are several types of water rates. They have different impacts on consumption. Major pricing approaches are the set price, the flat rate, the decreasing block rate, and the increasing block rate.



Set Price

With this rate structure each group of customers pays a set price for any amount of water consumed. The bill is the same whether 1,000 or 10,000 gallons are used each month. This type of structure must be used when there are no meters. The price offers no incentive to conserve water because the price is not linked to the quantity of water consumed.

Flat Rate

In this pricing arrangement the unit price of water is constant no matter how much is consumed. The cost to the customer increases in direct proportion to the amount of water consumed. There is an incentive to conserve, but it is the same for both large and small users.

Decreasing Block Rate

This rate structure is widely used by utilities today. The consumer pays a certain unit price for a volume, a lower unit price for the next volume, and so on. The cost of the water to the consumer increases as consumption increases, but at a decreasing rate. The incentive to conserve water decreases as consumption increases. In fact, the largest consumers have the least incentive to conserve.

Increasing Block Rate

The unit price of water increases in a stepwise manner under this rate structure. It is opposite of the decreasing block rate. This type of structure is justified, when the cost of water increases as demand increases. It provides an excellent incentive to conserve water.

Two other pricing strategies are possible. One is the "peak demand rate" which aims to flatten usage at high consumption times of the year or day. The other approach, the "life-line rate", provides a minimum amount of water at a small cost to all people. The life-line rate benefits people on fixed incomes such as the elderly.

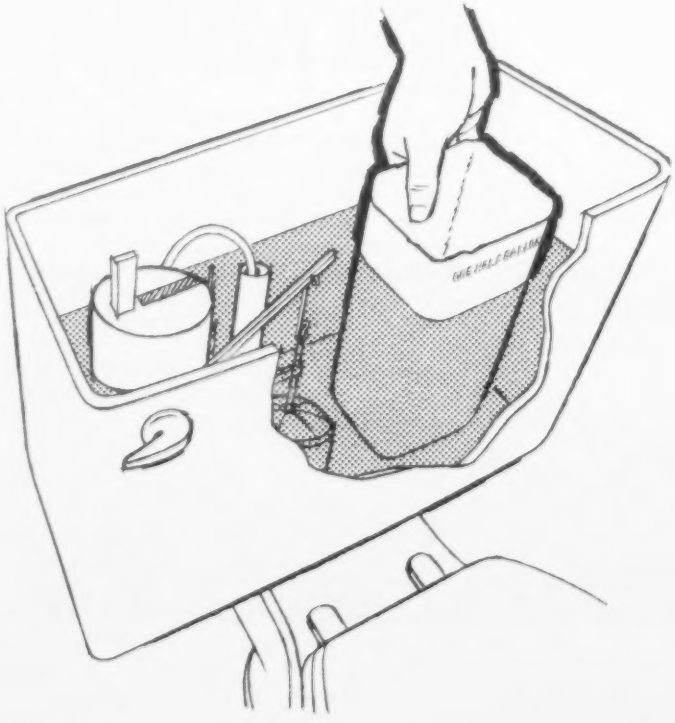
Water prices can be a most effective conservation tool. Upon recognizing the need for water conservation the advisory group should meet with the people responsible for water pricing. If the supplier is a non-profit government agency, it may be easier to adopt rates which encourage conservation. Private utilities may be more reluctant to change anything that will reduce their water sales. The advisory group may present examples of savings caused by changes in pricing. This action followed by an education campaign to mount public pressure may achieve some price changes.

Residential Water Conservation Devices

Residences use public water and generate wastewater. Each year there are more residential users. Each year many individuals use more water than the year before. The result can severely strain the capacity of water supply and wastewater treatment facilities. Residential water-conserving devices alleviate overload problems, or postpone construction of new supply or treatment facilities. The toilet and bath offer the greatest potential for conservation, since 75 percent of residential water is used there.

Toilet Devices

Adoption of the flush toilet may well have been one of man's worst decisions about disposing human wastes. Each of us use daily about 25 gallons of drinking water to flush wastes down the sewer. The conventional toilet, using 5 or more gallons of water per flush, can be modified to reduce water consumption. Plastic bottles filled with water and pebbles can be added to the reservoir tank in order to displace water. Several commercial devices serve similar functions. These devices can save as much as a gallon per flush. Recently many new types of toilets have come onto the market which reduce water consumption.



Water Use for Various Toilet Systems

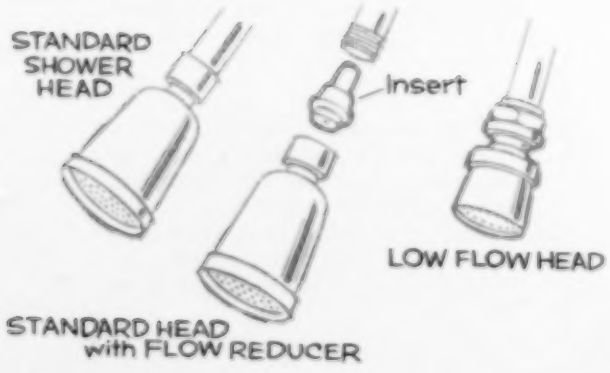
Type	Mechanism	Sewage Production Gallons/Flush
Conventional Water Closet	Water Carrier of Wastes	4.8-5.5
Conventional Water Closet	With Bottles or Dams Tank Volume Displacement	3.7-4.5
Modified Water Closet	Dual Flush Cycle and/or Reduced Tank Capacity	1.0-3.5
Vacuum or Air Toilet	Air or Vacuum Treatment	0.3-0.5
Recirculating Toilet	Filtered and/or Chemically Treated Water Recycled From Holding Tank	0.1-0.2
Incinerating Toilet	Liquids Evaporated and Solids Incinerated by High Temperature in Either Gas or Electric Furnace	0
Waterless Toilet	Composting or Oil Carrier Fluid with Incineration	0

Two types of conservation toilets, more properly called modified water closets, are now used in the United States. The more common water-saving toilets use 3.5 gallons per flush in contrast to the 5 gallons needed by the conventional types. These water-saving toilets look and function the same as conventional types, but accomplish a savings of 30 percent in water use. Dual flush systems, common in Europe, are rare in the United States. They can drastically reduce water use. The dual flush toilet has a 1.5 gallon flush for liquids and a 2.5 gallon flush for solids. They have a wall-mounted tank with a pipe running to the bowl mounted to the floor.

Recirculating toilets using chemically-treated water, incinerating toilets, and composting toilets are other options. These devices offer potential for rural and vacation homes where sites on land are unsuitable for septic tanks. However, they are relatively expensive.

Showerheads

Bathing represents the next largest amount of residential water consumption. Great potential exists for saving water (and energy used to heat water). Public attitudes play an important role in acceptance of the devices. Fortunately, showering is more common than bathing and has greater potential for water conservation. Simple devices can be inserted by the homeowner to reduce flows by restricting water at the showerhead. However, it is often just as easy and more effective to replace the showerhead with a new inexpensive water-saving model. Water savings in the range of 50 percent are feasible without customer dissatisfaction. Spray devices installed on lavatory and kitchen faucets will improve water use.



Water-Saving Washers

For years water-saving clothes washers called suds savers have been manufactured. However, lowering water levels and improved rinse systems can reduce water use up to 50 percent for clothes washing. Improved dishwashers have reduced water consumption by up to 38 percent.

Lawn Sprinkling

Some areas of the country depend heavily upon irrigation to keep their flowers, lawns, and valuable shrubs in good condition. Improved methods such as underground trickle irrigation can reduce demands considerably. The best conservation alternative for landscaping is to use native vegetation that can survive naturally in the existing climate without supplemental water.

Pressure-Reducing Valves

Lowering water pressure in a residence can reduce water usage. Many fixtures and appliances consume less water as pressure drops, but still perform adequately at minimum pressure. It is advisable to reduce maximum pressure in residential piping to 40 pounds per square inch. This can be done by installing a simple valve at your residential water inlet.

Economics

The potential annual net savings from installing retrofit devices in an existing suburban household was estimated at $54 in 1978 by the EPA. The installation of new devices in a new suburban home was estimated to save $96 annually.

The advisory group can encourage agencies or utilities to start a public education program to promote water conservation and water-saving devices. The advisory group can help citizens locate plumbing distributors stocking the devices. The residents should get advice from their water suppliers on how to measure the water use before and after the devices are installed, and how to check for leaks.

Things to Consider in a Water Conservation Plan

Two areas of caution relate to water conservation: consumer and utility company acceptance, and device and collection system maintenance. Most people are willing to make some change in habits, if they have good reasons. Education and good public relations are the keys to consumer acceptance.

Some water utilities have traditionally been opposed, or at least indifferent, to water conservation. As long as there was sufficient supply and no restriction on disposal, added volume or usage meant added profits. However, faced with the problems of limited supplies and consumer complaints over increased costs, attitudes are changing. Nevertheless, utilities agree that water conservation may increase rates. This results from the utility's high fixed costs, which remain unchanged no matter what volume of water is sold. The

Potential Savings for Installing Devices in a Typical Suburban Household

Type of Construction	Devices	Daily Water Saving	Annual Savings per Household*
1. Retrofit in Existing Homes	Displacement toilet dams Fine spray showerheads	49 gal (23%)	$54
2. New Homes	Water-conserving toilets Fine spray showerheads Water-saving clothes washer Spray on lavatory faucets Water-saving dishwasher	74 gal (35%)	$96

**Includes in-house hot water energy saving.*

utility's costs go down, but the cost to any given user may go up, down or remain the same. The means of making the rate impact equitable for all users depends on pricing policies.

Extensive water conservation has caused some problems for wastewater collection and treatment. During a severe drought in Marin County, California, it was necessary to flush sewers to transport solids when sewage flows dropped to 25 percent of the normal amounts. Modest reductions in flow produce no adverse effects. It is also expected that pollutant concentrations in the effluent from some treatment plants may rise as flow goes down, but overall removals in terms of pounds of pollutants per day will decrease. On the other hand, many already overloaded plants produce improved effluent when flows are reduced.

Toilet retrofit device maintenance can be a problem. Some makes of toilet devices may cause double flushes. Others occasionally become displaced and cause toilet malfunctions. They are simple to repair if the user is aware of the problem. Any conservation program using toilet retrofit devices should evaluate the device prior to its adoption.

Reuse

The reuse of water has been going on for a long time. Reuse occurs through the hydrologic cycle, groundwater recharge from septic tanks, and upstream-downstream uses of water. For example, it is estimated that water is reused seven times on the Ohio River in its journey from Pittsburgh to the Mississippi River.

Recently large-scale controlled reuse of water has been implemented. Reuse may take many forms. Examples include agricultural and residential irrigation, impoundment in lakes for recreation and wildlife, groundwater recharge, industrial cooling, and consumption for both drinking and industrial processes.

Municipal wastewater recycle for potable use (drinking water) began in South West Africa in 1970. Municipal sewage is reclaimed by physical/chemical treatment to make up 30 percent of the public water supply. No such direct potable use is made in United States. Customer acceptance is expected to be a major problem even if public health considerations are satisfied. Municipal wastewater has been revised in the United States for industrial cooling water and agricultural or horticultural irrigation water. Land treatment of wastewater is really a form of reuse. A good example is Muskegon County, Michigan, where effluent provides irrigation water for crops. The crops remove the nutrients from the wastewater before it is returned to the stream or groundwater. Municipal wastewater also can contribute to recreational lakes. An example is the Santee project in California.

Industrial "closed loop" with internal recycle of water has been performed for many years. However, it is being considered by more industries as we move towards the 1985 goal of The Clean Water Act: the "zero discharge" of pollutants.

Agricultural irrigation reuse is common, but it may cause additional downstream use problems because of higher total dissolved solids in the water. Residential reuse (recycle) has been investigated in several demonstration projects. Treatment, storage, and reuse for toilet flushing and lawn sprinkling are considered to be economical only for problem onsite disposal areas and high water cost areas. However, dwindling water supplies and rate increases may make residential reuse more attractive.

Many innovative and alternative technologies reuse and recycle water. Many result in aquifer recharge. Others produce saleable energy and marketable crops. This revenue reduces operation costs. Multiple use is another form of reuse. Municipal wastewater reuse projects qualifying as innovative and alternative technologies may receive 85 percent federal funding in the Construction Grants Program. This is an increase of 10 percent over projects utilizing conventional treatment methods.

An advisory group can encourage the grantee to consider the wastewater as a resource rather than a liability. This wastewater can be valuable in water-short areas. However, the nutrients in wastewater are also a resource that has made land application attractive even in areas with adequate water supplies. Water reuse requires public acceptance and support. An advisory group can promote water reuse through the public and the organizations that it represents. In several instances land treatment has been opposed because of the public fear of health hazards. Decades of research has dispelled most of these concerns. The advisory group can help to alleviate fears by explaining the facts. An advisory group can ask that these options be considered during facilities planning.

Conclusions

There are many reasons why water should be conserved. The most obvious reason is a limited supply. Less apparent, but just as valid, reasons include: wastewater load reduction, reduction in water pollution, energy and chemical savings, and potential for reduced capital investment for both water treatment and wastewater treatment facilities.

Probably the greatest potential for reduction in water usage lies with industry. However the best opportunities for public water savings is in residences, where 45 percent is used for toilets and 30 percent for bathing. How to reduce water usage is a multifaceted problem. Public awareness and education coupled with changes in pricing, regulation, and plumbing codes can result in dramatic savings in water and energy. The most tangible economic benefit to consumers is in reduced energy bills.

Residential water conservation may be obtained using readily available devices which require little or no change of habits for their usage. Water-conserving toilets and showerheads are best for new construction, while retrofit devices may be easily installed in existing homes.

Controlled water reuse is another option. Resource and economic benefits can be gained by reusing or recycling water or wastewater effluent for agricultural, industrial, and other purposes.

The exact scheme chosen for water conservation in your area will depend on the particular needs of your community. These can be determined through Section 208 studies, as well as 201 facilities planning. Remember that water conservation and reuse may not completely solve your water pollution problem, but they can be useful tools.

Water conservation and reuse must be evaluated during the cost-effectiveness analysis conducted as part of facility planning. The advisory group should insure that the conservation and recycle alternatives are given adequate consideration.

Uniform Rate Structure, Retrofit, and Education

Elmhurst, Illinois

Excerpted from "Two Cities Meet Conservation Challenge", Myer, L. et al. Water and Sewage Works, pp. 60-61, March 1979

Elmhurst, Illinois, is a community of 50,000 people that solved a water-supply shortage through water conservation. Its water is supplied primarily from deep wells. Since 1957, withdrawals had been exceeding the rate of recharge. Also, the sewage treatment plant had reached its hydraulic limit.

Program

Elmhurst's goal was to:

- Reduce water consumption by 10 to 15 percent and sewage treatment plant hydraulic loads by 8 to 10 percent
- Reduce both maximum day and peak-hour consumption
- Eliminate the necessity for a new deep well.

An important part of the water conservation program was public education. This included:

- A water bill mailing insert
- Newsletters sent to all residents describing the water-supply problem and conservation program, with suggested methods to conserve water
- Local newspaper, radio and TV coverage.

Until 1975, Elmhurst used a declining block rate structure (unit charge decreased as consumption increased) for water and sewer service. It decided that the most equitable rate structure for a primarily residential community was a uniform unit charge rate, independent of consumption volume. In late 1975, Elmhurst instituted an excess usage water rate, based upon findings that a small percentage of users were responsible for the high summer water demands. The water system was designed for the summer peak-hour and maximum daily consumption. So, it was underused in the winter. The new rate charged the cost of excess supply and storage capacity to the users responsible for it.

To save significant amounts of water quickly, Elmhurst delivered to each home a set of toilet displacement dams, restriction device for showerheads, and dye tablets to check for toilet-flush leakage. The community spent approximately $1 per person for the public education program, purchase of water-saving devices, and labor.

Results

Preliminary results show that:

- The nine wells previously needed to meet summer peak demand were reduced to seven
- Water consumption was reduced by 15 percent
- Wastewater loads were reduced by 10 percent, providing additional capacity for 5,000 people
- Expenditure of $400,000 for a new deep well was deferred.

Plumbing Code Change and Retrofit Program

North Tahoe Public Utility District, Nevada

From presentation made by Hassenplug, J. and Esking, N. at the 1978 American Water Works Association Conference in Atlantic City, NJ, "Water Conservation Methods Practical and Legal Aspects", June 1978.

The North Tahoe Public Utility District is a public entity operating a domestic water supply and distribution system serving a part of California and Nevada. The area is primarily comprised of second homes, condominiums, motels, and some commercial establishments. Tourism is the primary industry. Approximately 25 percent of the housing stock is occupied year-round.

The District began developing a water conservation program in January, 1976, as a method for reducing sewage flows, although realization of a severe drought in California was just beginning.

Problem

Implementation of a water conservation program was a major problem, since:

- Many operators of tourist facilities believed water conservation restrictions would infringe on the visitors' enjoyment of the area and disrupt tourism
- There were few other programs to imitate and information on water-saving devices was sketchy
- Legal basis for operating the program was uncertain
- Governmental structure also hampered the program.

Within the Tahoe basin, relevant governmental entities included: the federal government, two states, five counties, the Tahoe Regional Planning Agency, The California-Tahoe Regional Planning Agency, and the Nevada-Tahoe Regional Planning Agency, as well as numerous public utility districts and private water companies.

Program

The program objective was to achieve water conservation in a passive manner without requiring or prohibiting direct action by water users. This was particularly important because of the transient population.

The District had ordinance-adopting powers pursuant to state law, but depended upon Placer County for enforcement. Working closely together, the District and the County adopted essentially the same ordinance, presenting a united front to the utility user. The county ordinance was also effective over a wide geographical area, encouraging other districts to conserve water.

The following design for a water conservation ordinance was given:

1. The ordinance distinguished between different classes of water use, and between existing and new construction.

2. Certain types of conservation were mandated. These were all physical installations and not changes in human actions. The devices used were water-saving showerheads, aerators, and toilets. Self-closing lavatory valves were mandated under certain conditions.

3. A retrofit education program was developed to convince users that both new and old users were treated fairly. Further, the District conducted most retrofit programs to insure proper installation.

4. A timetable was set forth for compliance: 30 days after adoption for all new users and 8 months for retrofitting. Failure to conform involved penalties of $500 for each day after notification, and shutoff of services if compliance was not forthcoming.

Conservation device selection was made by ordering several types of each device and subjecting them to tests.

The estimated cost of the retrofit installation program was based on these assumptions: two toilets/house, two showers/house, one man-hour/house for installation, and 0.4 man-hour/house for follow-up service for installation in ten percent of the houses. Installation teams operated in pairs, preferably of mixed sexes. Shower flow devices and toilet tank dams were scheduled for initial installation. Faucet aerators were scheduled for the second and third years of the program. This enabled crews to check initial installation and review of the program with the customer.

Very few problems were encountered by the crews. In places where the dams wouldn't fit, plastic bottles were used. No bricks were used. In the case of vandal-proof showerheads and in cases where the showerhead would not fit the device, a new shower arm or showerhead was installed. Complaints were rare. Public cooperation and support were excellent due to the large amount of publicity given the program.

The publicity program of radio announcements, press releases, and flyers, sent with all water bills preceded door-to-door canvassing. The flyers also provided information for making appointments to have the service done. The publicity campaign also included: poster and essay contests, a water conservation fair, and distribution of water conservation buttons, T-shirts, balloons, and stickers. Area restaurants were provided with table tents and posters indicating water was available on "request only". In addition a school education program was tied in with the current science curriculum.

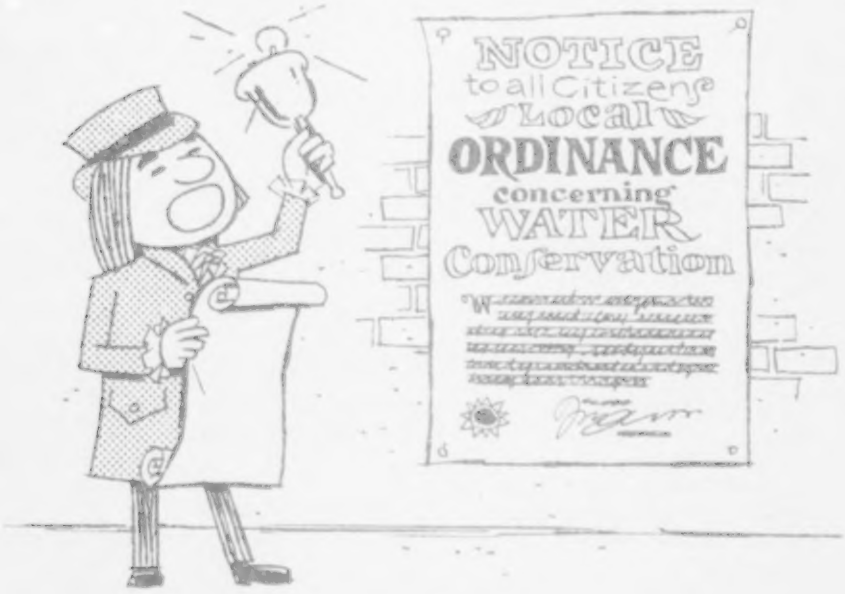
Results

The average water savings for 12 area motels was about 40 percent during the second and third quarters of the year. These periods do not include ski seasons in which usage is highly variable. Several lessons were learned during the program. They include: Different water-saving devices will be needed for a program. Devices should not be purchased all at once since better ones may appear on the market at any time. Good publicity, education, and public relations are essential aspects of a program.

The following suggestions are offered for implementation of a water conservation ordinance:

1. Analyze the political structure of the area where the legislation is to be effective. It is desirable to coordinate the adoption and implementation of the rules with the agencies most involved with enforcement.

2. Avoid allying a program with a controversial agency, particularly with a planning agency involved in growth control. Such action will have the effect of linking the program with controversial and negative issues, thus diminishing public cooperation.



Peak Demand Surcharge Rate

Dallas, Texas

Excerpted from "Water Conservation—A Practical Approach", by Rice I. and Shaw, L. Journal of American Water Works Association, *p. 481, 482. September 1978.*

Education and information have long been tools in the Dallas, Texas, water conservation program. Their primary value, however, has been supplemental to more direct conservation measures. The Dallas solution was to use pricing policy as a tool to achieve conservation of water resources. A pricing policy must be tailored to the circumstances of an individual community, whose leaders and administrators best understand where significant conservation is possible and how it can be achieved. In the United States the price mechanism is easily understood and its impact is readily assessable. Three elements —knowledge of customer water use, customer understanding of rate structure, and customer ability to assess economic impact of conservation measures—are essential to an effective water conservation program.

Program

In Dallas the customer having the most potential for significant water conservation is the single-family residential consumer. The hot, dry summers typical of northcentral Texas from June through September create a heavy, but relatively short-term demand for yard irrigation to preserve grass, shrubs, and trees. Therefore, the initial focus of the Dallas conservation program was directed to the high-usage residential consumer during summer months. The program objectives were twofold: To lower (1) the average residential consumption, and (2) the peak-hour and maximum-day demands upon the treatment and distribution system, as compared to previous years under similar weather conditions. The first objective was an attempt to reduce the need for future supply reservoirs; the second objective tried to reduce the need to expand the capacity of water purification plants and the distribution systems. The strategy was to formulate a rate structure based on cost of service to accomplish these objectives.

A number of approaches to changing the residential rate structure were considered. Dallas chose to adopt and implement a surcharge for monthly consumption above a specified level during the summer months (June-September). In 1976 a major fraction of the water was consumed by large users (above 20,000 gallons per month). It was felt that the rate structure must affect these users if a significant impact on traditional consumption patterns was to be achieved.

Dallas, Texas, Rates for Water Service: 1977

Monthly Consumption	Old Rate $/1000 gal	New Rate $/1000 gal	Rate Increase Percent
First (8,000 gal)	0.58	0.61	5
Next (12,000 gal)	0.51	0.61	22
Over (20,000 gal) (winter months, Oct.-May)	0.50	0.61	22
Over (20,000 gal) (summer months, June-Sep.)	0.50	0.79	58
Overall increase in revenue requirement			12

Results

The results of the first summer's experience with the new surcharge feature and other rate structure modifications must be considered preliminary but they do seem extremely encouraging. For example, the maximum-day to average-day demand in 1977 declined 8 percent from the average of the last five years, even though weather conditions were the same or more severe than those experienced during any year of the last five-year period. Also, the maximum-day pumpage in 1977 declined 12 percent from that experienced in 1974. If the preliminary view is correct, the new pricing policy may have saved the Dallas system the equivalent of a 50 to 75 mgd treatment plant at no cost.

It is believed that Dallas is the first major city to adopt a pricing policy that places a surcharge on heavy demand residential customers during peak usage periods. In Dallas this represents a stage in evolution from a pricing policy that, over 25 years ago, gave a declining rate to heavy consumers, to the policy adopted in the 1950's of a flat rate, to the present system of heavy-demand surcharge. When the current rate structure was presented to the city council for approval, the surcharge portion of the rates was described as a response to a previously expressed desire of the council to increase water conservation in Dallas.

Recycle and Reuse
California

Excerpted from "Water Conservation Through Wastewater Reuse", by M. L. Wasserman, Proceedings of National Conference on Water Conservation and Municipal Wastewater Flow Reduction, November 28, 29, 1978 Chicago, IL sponsored by the EPA. EPA 430/9-79-015, August 1978.

The following case studies illustrate a variety of reclaimed water producers, users, and industrial recyclers:

• **Burbank Power and Light.** About 10 years ago, the City of Burbank was sending all its wastewater to the City of Los Angeles for treatment and disposal. To reduce the cost of wastewater disposal and to conserve water, Burbank built a 7 mgd sewage treatment facility with outflow supplying the 1.2 mgd cooling water requirements of the Burbank Power and Light generating station.

The cost of city supplied water is much more expensive than reclaimed water. City water in 1978 sold for more than five times the cost of reclaimed water. In terms of costs for water purchase and including chemical treatment to control pH, scaling, hardness, and coliform organisms, total cost savings to the power plant amounted to $6,300 per month.

• **Simpson Paper Company.** Simpson Paper Company's Shasta Mill near Anderson, California, operates under some of the most stringent water quality regulations in the United States. The regulations are tight because the mill discharges to the Sacramento River, a highly productive fish spawning ground. Wastewater discharges resulting from a plant expansion in 1974 could not be economically treated to meet discharge standards. The company then investigated the use of secondary effluent for irrigating croplands.

Presently the mill produces 2.6 mgd of reclaimed water for irrigating 650 acres of cropland. A fully automated flood irrigation system is used to supply the water to the land. Good yields of oats, wheat, and field corn are achieved.

This land has highly permeable soil, which allows the effluent to percolate rapidly to the riverbed. During the recent drought when Sacramento River flows were very low, the Shasta Mill was able to meet the most stringent conditions prescribed in its discharge permit.

• **Irvine Ranch Water District.** In 1972 the Irvine Ranch Water District adopted a water resources master plan which provided for maximum use of the District's total water resources, including fresh water supply, the collection and treatment of wastewater, and the extensive use of reclaimed water. In assessing options for effluent disposal, the District chose a total reclamation and reuse alternative, rather than ocean disposal. Two key points became evident in the analysis of the alternatives. First, the degree of treatment had become virtually the same for the two alternatives largely because of increasingly stringent water quality standards for ocean disposal. Second, the cost of the total reclamation program was $1.25 million less per year than the ocean disposal route—mainly because the District could earn a potential $4 million annually by selling reclaimed water. Presently, it supplies 5 mgd of reclaimed water for irrigation of citrus orchards, vegetable crops, parks, community greenbelts, and golf courses.

The District sells reclaimed water for $69.06/ac-ft, compared to the $143.75/ac-ft charge for Colorado River water imported for domestic uses. High in nitrogen and phosphorus, the reclaimed water is calculated to have a fertilizer value of $30/ac-ft, which at prevailing irrigating volumes comes to about $120/acre/yr. To the farmer this means fertilizer cost-savings on top of the water cost-savings obtained by purchasing reclaimed water at half the price of freshwater.

Need More Information?

A Pilot Water Conservation Program. Bulletin 191. Sacramento, CA: California Department of Water Resources, October 1978. 64 p.

This bulletin reports on a study of the best and most cost-effective ways to introduce water-saving devices into homes. The study includes pilot programs in six California cities that were affected by the severe 1976-77 drought. The study will be of value to water suppliers and citizen groups interested in water conservation. Eight appendices are also available, including a device study and the study of each of the six cities. The report is available at no cost from California Department of Water Resources, P.O. Box 388, Sacramento, CA 95802; attn: Dean Thompson.

Agricultural Water Conservation Conference Proceedings. Sponsored jointly by California Department of Water Resources and the University of California Cooperative Extension Service, June 1976. 249 p.

These proceedings resulted from a conference on agricultural water conservation in California; however many of the conclusions are applicable nationwide. Both approaches and policy are discussed in these proceedings. It is available from California Department of Water Resources, P.O. Box 388, Sacramento, CA 95802; attn: Dean Thompson.

Directory of Federal Programs Related to Water Conservation. Draft copy. Washington, DC: U.S. Environmental Protection Agency, Office of Water Programs Operations, November 1978. 72 p.

This is a directory of federal programs by agency including type of assistance, nature of program, water conservation provisions, eligibility, fiscal scope of program, applicant eligibility, and informational contact. It is available from EPA, Facility Requirements Division (WH 595), 401 M Street, S.W., Washington, DC 20460.

Milne, M. *Residential Water Conservation.* California Water Resources Center Report No. 35. Davis, CA: University of California, 1976. 469 p.

A comprehensive but non-technical report on residential water conservation covering factors influencing water use, devices, and applications. It also discusses costs of treatment of wastes and laws from the California viewpoint. It is available for $14.50 as order no. PB-253-253/9 from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

McGhee, R., et al., eds. *Readings in Water Conservation.* Washington, DC: National Association of Counties Research, Inc., 1978. 332 p.

This document represents an extensive collection and synthesis of recent publications in water conservation. Areas covered extensively are regulations, infiltration and inflow, devices, education, land use, planning, pricing policies, economics and reuse. This collection represents national scope. Copies may be obtained from National Association of Counties Research, Inc., 1735 New York Avenue, N.W., Washington, DC 20006.

Water Conservation Devices, Residential Water Conservation. Water Research Capsule Report. Washington, DC: U.S. Department of Interior, Office of Water Research and Technology, 1977. 10 p.

This capsule report highlights findings of research projects funded through the Office of Water Research and Technology. It is a simple overview of the subject and is suitable for lay persons desiring information on residential water conservation. It is available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 as Stock Number 924-000-00834-1, at a cost of $0.90 per copy.

Glossary

Acid-Mine Drainage—water with an acidic pH seeping from working or abandoned mines.

Alternative Wastewater Treatment System—a group of wastewater treatment systems as defined by EPA that can save energy or cost as compared to conventional treatment systems.

Aquifer—underground bed or layer of earth, gravel, or porous stone which serves as a reservoir for groundwater.

Aquifer Recharge—adding water to an aquifer either by spreading on the ground surface or direct injection through wells.

Coliform—organisms found in the intestinal tracts of humans and other animals.

Composting—a method of breakdown of organic matter using natural decay processes.

Cost-Effectiveness Analysis—determination of whether a project or technique is worth funding; both monetary and nonmonetary factors are involved.

Decreasing Block Rate Structure—cost of water to consumer increases as consumption increases, but at a decreasing rate.

Dissolved Solids—total amount of extremely small organic and inorganic material.

Effluent—treated or untreated waste material discharged into the environment.

Flat Rate Structure—unit price of water is constant no matter how much is consumed.

Horticulture—science of growing flowers, fruits, and vegetables.

Hydraulic Overload—situation when a wastewater treatment plant is unable to handle the large flow of water entering it.

Increasing Block Rate Structure—cost of water to consumer increases as consumption increases, and at an increasing rate; also known as a penalty structure.

Industrial Closed Loop—the treatment and reuse of waters used in production within an industrial plant so that no water leaves the plant.

Infiltration and Inflow (I/I)—leakage of ground and surface water into sewers.

Innovative Waste Treatment System—systems that, through new ideas and techniques, significantly reduce costs or use of energy, improve control of toxic materials, improve operational reliability, or result in some other public benefit.

Life-Line Rate Structure—schedule providing a minimum basic amount of water at a small cost to all people.

Onsite Disposal—disposal of wastewater on an individual lot, usually by a septic tank.

Peak Demand Rate Structure—increases price of water at high consumption periods; effect of leveling out water usage.

Per Capita Daily Consumption—amount consumer per person per day.

Percolation—downward flow or filtering of water through pores or spaces in rock or soil.

Retrofit Devices—modifications to be installed on existing equipment.

Set Price Rate Structure—each group of customers pays a set amount for any amount of water consumed.

Silviculture—phase of forestry dealing with the establishment, development, reproduction, and care of forest trees.

Unit Processes—the individual functioning parts of a whole system.

Watershed—the land area that drains into a particular surface water.